

CLAIMS

1. A light source apparatus comprising a light source and a concave mirror for condensing light emitted from the light source, the light source apparatus comprising:

a movable substrate that is set on a bottom plate of the light source apparatus and is movable in a traveling direction of light condensed by the concave mirror; and

a concave mirror anchoring plate for anchoring the concave mirror to the movable substrate.

2. The light source apparatus according to claim 1, further comprising a concave mirror fixing member for fixing the concave mirror to the concave mirror anchoring plate, wherein the concave mirror fixing member is a plate spring made of stainless steel.

3. The light source apparatus according to claim 2, wherein a thickness of the plate spring is greater than 0.2 mm, but is smaller than 0.5 mm.

4. The light source apparatus according to claim 1, further comprising on the bottom plate, a positioning member for fixing a condensed-state confirming means used when adjusting a position of the concave mirror with respect to the bottom plate.

5. The light source apparatus according to claim 1, further comprising a movable substrate fixing member for fixing the movable substrate to the bottom plate.

6. The light source apparatus according to claim 1, wherein an arc lamp is used as the light source, and a center of a luminous part of the arc lamp coincides with a first focal point of the concave mirror.

7. The light source apparatus according to claim 1, wherein the concave mirror is an ellipsoidal mirror.

8. A light source apparatus comprising a light source, a first

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concave mirror for condensing light emitted from the light source, and a second concave mirror having a reflection surface opposing a reflection surface of the first concave mirror, the light source apparatus comprising:

5 a movable substrate that is set on a bottom plate of the light source apparatus and is movable in a traveling direction of light condensed by the first concave mirror;

a first concave mirror anchoring plate for anchoring the first concave mirror to the movable substrate; and

10 a second concave mirror anchoring plate that is attached to the first concave mirror anchoring plate and anchors the second concave mirror.

9. The light source apparatus according to claim 8, further comprising a first concave mirror fixing member and a second concave mirror fixing member for fixing the first and second concave mirrors to the first and second concave mirror anchoring plates, respectively, wherein the first and second concave mirror fixing members are plate springs made of stainless steel.

20 10. The light source apparatus according to claim 9, wherein a thickness of the plate springs is greater than 0.2 mm, but is smaller than 0.5 mm.

25 11. The light source apparatus according to claim 8, further comprising on the bottom plate, a positioning member for fixing a condensed-state confirming means used when adjusting a position of the first concave mirror with respect to the bottom plate.

30 12. The light source apparatus according to claim 8, further comprising a movable substrate fixing member for fixing the movable substrate to the bottom plate.

35 13. The light source apparatus according to claim 8, further comprising an anchoring plate position adjusting means that adjusts relative positions of the first and second concave mirror anchoring plates.

14. The light source apparatus according to claim 13, wherein the anchoring plate position adjusting means is placed at four corners of the

first and second concave mirror anchoring plates.

5 15. The light source apparatus according to claim 8, further comprising an anchoring plate fixing means for fixing relative positions of the first and second concave mirror anchoring plates.

10 16. The light source apparatus according to claim 15, wherein the anchoring plate fixing means is placed at four corners of the first and second concave mirror anchoring plates.

17. The light source apparatus according to claim 8, wherein an arc lamp is used as the light source, and a center of a luminous part of the arc lamp coincides with a first focal point of the first concave mirror.

15 18. The light source apparatus according to claim 8, wherein the first concave mirror is an ellipsoidal mirror.

19. The light source apparatus according to claim 8, wherein the second concave mirror is a spherical mirror.

20 20. A lighting system comprising a light source apparatus according to any one of claims 1 to 7, and an optical means for converting light condensed by the concave mirror of the light source apparatus into approximately parallel light.

25 21. A lighting system comprising a light source apparatus according to any one of claims 8 to 19, and an optical means for converting light condensed by the first concave mirror of the light source apparatus into approximately parallel light.

30 22. A projection display system comprising a light source apparatus according to any one of claims 1 to 7, an optical means for converting light condensed by the concave mirror of the light source apparatus into approximately parallel light, an optical modulator for forming an optical image by modulating light emitted from the optical means, and a projection lens for projecting the optical image.

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23. A projection display system comprising a light source apparatus according to any one of claims 8 to 19, an optical means for converting light condensed by the first concave mirror of the light source apparatus into approximately parallel light, an optical modulator for forming an optical image by modulating light emitted from the optical means, and a projection lens for projecting the optical image.

Sub B. 24. An adjusting device for adjusting an optical arrangement, for a light source apparatus comprising a light source, a concave mirror for condensing light emitted from the light source, a movable substrate that is set on a bottom plate of the light source apparatus and is movable in a traveling direction of light condensed by the concave mirror, and a concave mirror anchoring plate for anchoring the concave mirror to the movable substrate, using an adjusting light source before mounting the light source, the adjusting device comprising:

an adjusting light source fixing means that is attached to the concave mirror anchoring plate and fixes a center of a luminous part of the adjusting light source at a predetermined optical position with respect to the concave mirror.

25. The adjusting device according to claim 24, wherein the predetermined optical position is a first focal point of the concave mirror.

26. The adjusting device according to claim 24, further comprising a condensed-state confirming means for observing a state of light emitted from the adjusting light source condensed by the concave mirror.

27. The adjusting device according to claim 26, wherein the condensed-state confirming means has a surface on which light is condensed, which is set perpendicularly to an optical axis of light emitted from the adjusting light source and reflected by the concave mirror.

28. The adjusting device according to claim 27, wherein the surface is positioned and fixed on the bottom plate of the light source apparatus so that the surface is located at a position where a second focal point of the concave mirror should be placed.

29. The adjusting device according to claim 26, wherein the condensed-state confirming means is an optical sensor.

5 30. The adjusting device according to claim 24, wherein any of a tungsten lamp, a halogen lamp, a semiconductor laser light source, and an outgoing end of light-transmitting optical fiber is used as the adjusting light source.

10 31. An adjusting device for adjusting an optical arrangement, for a light source apparatus comprising a light source, a first concave mirror for condensing light emitted from the light source, a second concave mirror having a reflection surface opposing to a reflection surface of the first concave mirror, a movable substrate that is set on a bottom plate of the light source apparatus and is movable in a traveling direction of light condensed
15 by the first concave mirror, a first concave mirror anchoring plate for anchoring the first concave mirror to the movable substrate, and a second concave mirror anchoring plate that is attached to the first concave mirror anchoring plate and anchors the second concave mirror, using an adjusting light source before mounting the light source, the adjusting device
20 comprising:

an adjusting light source fixing means that is attached to the first concave mirror anchoring plate and fixes the adjusting light source movably so that a center of a luminous part of the adjusting light source is located at a predetermined optical position.

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32. The adjusting device according to claim 31, wherein the predetermined optical position includes a first focal point of the first concave mirror and a position where a center of curvature of the second concave mirror should be placed.

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33. The adjusting device according to claim 31, further comprising a first condensed-state confirming means for observing a state of light emitted from the adjusting light source condensed by the first concave mirror.

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34. The adjusting device according to claim 33, wherein the first condensed-state confirming means has a surface on which light is

condensed, which is set perpendicularly to an optical axis of light emitted from the adjusting light source and reflected by the first concave mirror.

5 35. The adjusting device according to claim 34, wherein the surface of the first condensed-state confirming means is positioned and fixed on the bottom plate of the light source apparatus so that the surface is located at a position where a second focal point of the first concave mirror should be placed.

10 36. The adjusting device according to claim 33, wherein the first condensed-state confirming means is an optical sensor.

15 37. The adjusting device according to claim 31, further comprising a second condensed-state confirming means for observing a state of light emitted from the adjusting light source condensed by the second concave mirror.

20 38. The adjusting device according to claim 37, wherein the second condensed-state confirming means has a surface on which light is condensed, which is set perpendicularly to an optical axis of light reflected by the first concave mirror.

25 39. The adjusting device according to claim 38, wherein the surface of the second condensed-state confirming means is attached to the adjusting light source fixing means so that the surface is located at a position where a center of curvature of the second concave mirror should be placed.

30 40. The adjusting device according to claim 38, wherein the surface of the second condensed-state confirming means is placed within a vessel of the adjusting light source.

35 41. The adjusting device according to claim 31, wherein any of a tungsten lamp, a halogen lamp, a semiconductor laser light source, and an outgoing end of light-transmitting optical fiber is used as the adjusting light source.

42. A method for manufacturing a light source apparatus

comprising a light source, a concave mirror for condensing light emitted from the light source, a movable substrate that is set on a bottom plate of the light source apparatus and is movable in a traveling direction of light condensed by the concave mirror, and a concave mirror anchoring plate for anchoring the concave mirror to the movable substrate, the method comprising:

mounting the movable substrate on the bottom plate;
attaching the concave mirror anchoring plate to the movable substrate;

mounting an adjusting light source so that a center of a luminous part of the adjusting light source is located at a first optical basis position with respect to the concave mirror attached to the concave mirror anchoring plate;

placing a condensed-state confirming means for observing a state of light condensed by the concave mirror at a second optical basis position;

adjusting a position of the movable substrate on the bottom plate so that a condensed state of light observed by the condensed-state confirming means is optimum; and

removing the adjusting light source and mounting the light source so that a center of a luminous part of the light source coincides with the position where the center of the luminous part of the adjusting light source has been located.

43. The method for manufacturing a light source apparatus according to claim 42, wherein the first optical basis position is a first focal point of the concave mirror.

44. The method for manufacturing a light source apparatus according to claim 42, wherein a second optical basis position is a position where a second focal point of the concave mirror should be placed.

45. The method for manufacturing a light source apparatus according to claim 42, wherein the position of the movable substrate is adjusted by a process comprising:

moving the movable substrate to such a position that a diameter of a light spot observed by the condensed-state confirming means at a minimum and fixing the movable substrate at the position;

adjusting a fixed position of the concave mirror with respect to the concave mirror anchoring plate so that the position of the light spot approaches the second optical basis position; and

again, moving the movable substrate to such a position that the diameter of the light spot observed by the condensed-state confirming means at a minimum and fixing the movable substrate at the position.

46. A method for manufacturing a light source apparatus comprising a light source, a first concave mirror for condensing light emitted from the light source, a second concave mirror having a reflection surface opposing to a reflection surface of the first concave mirror, a movable substrate that is set on a bottom plate of the light source apparatus and is movable in a traveling direction of light condensed by the first concave mirror, a first concave mirror anchoring plate for anchoring the first concave mirror to the movable substrate, and a second concave mirror anchoring plate that is attached to the first concave mirror anchoring plate and anchors the second concave mirror, the method comprising:

mounting the movable substrate on the bottom plate;
attaching the first concave mirror anchoring plate to the movable substrate;

attaching the second concave mirror anchoring plate to the first concave mirror anchoring plate;

mounting an adjusting light source so that a center of a luminous part of the adjusting light source is located at a first optical basis position with respect to the first concave mirror attached to the first concave mirror anchoring plate;

placing a first condensed-state confirming means for observing a state of light from the adjusting light source condensed by the first concave mirror at a second optical basis position;

adjusting a position of the movable substrate on the bottom plate so that the condensed state of light observed by the first condensed-state confirming means is optimum;

moving the adjusting light source so that a center of a luminous part of the adjusting light source is located at a third optical basis position with respect to the second concave mirror;

placing a second condensed-state confirming means for observing a state of light condensed by the second concave mirror at a fourth optical

basis position;

adjusting a position of the second concave mirror anchoring plate with respect to the first concave mirror anchoring plate so that the condensed state of light observed by the second condensed-state confirming means is optimum; and

removing the adjusting light source and mounting the light source so that a center of a luminous part of the light source coincides with the first optical basis position.

47. The method for manufacturing a light source apparatus according to claim 46, wherein the first optical basis position is a first focal point of the first concave mirror.

48. The method for manufacturing a light source apparatus according to claim 46, wherein the second optical basis position is a position where a second focal point of the first concave mirror should be placed.

49. The method for manufacturing a light source apparatus according to claim 46, wherein the third optical basis position is a position where a center of curvature of the second concave mirror should be placed.

50. The method for manufacturing a light source apparatus according to claim 46, wherein the fourth optical basis position is a first focal point of the first concave mirror.

51. The method for manufacturing a light source apparatus according to claim 46, wherein the position of the movable substrate is adjusted by a process comprising:

moving the movable substrate to such a position that a diameter of a light spot observed by the first condensed-state confirming means at a minimum and fixing the movable substrate at the position;

adjusting a fixed position of the first concave mirror with respect to the first concave mirror anchoring plate so that a position of the light spot approaches a position where a second focal point of the first concave mirror should be placed; and

again, moving the movable substrate to such a position that the diameter of the light spot observed by the first condensed-state confirming

means at a minimum and fixing the movable substrate at the position.

52. The method for manufacturing a light source apparatus according to claim 46, wherein the position of the second concave mirror anchoring plate with respect to the first concave mirror anchoring plate is
5 adjusted by a process comprising:

moving the second concave mirror anchoring plate in parallel with an optical axis of light reflected by the first concave mirror and fixing the second concave mirror anchoring plate so that a diameter of a light spot
10 observed by the second condensed-state confirming means at a minimum;

adjusting a fixed position of the second concave mirror with respect to the second concave mirror anchoring plate so that a position of the light spot approaches the fourth optical basis position; and

again, moving the second concave mirror anchoring plate in parallel
15 with the optical axis of light reflected by the first concave mirror and fixing the second concave mirror anchoring plate so that the diameter of the light spot observed by the second condensed-state confirming means at a minimum.